US 36/SR 4 & Milford Avenue Traffic Study

Marysville, Ohio

January 23, 2009

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Introduction

The purpose of this document is to provide an assessment of the US 36/SR 4 intersection with Milford Avenue in Marysville, Ohio. This intersection is located on the southwestern portion of the city, near the city limits. A map with the intersection location is shown on **Figure 1**. This study will provide short-term and long-term recommendations for the intersection.

The speed limit on US 36/SR 4 is 55 miles per hour. The speed limit on Milford Avenue is 35 miles per hour. Payne Road has a 45-mph posted speed limit. US 36/SR 4 is a limited-access highway from approximately 1000 feet south of Milford Avenue north to the US 33 freeway.

US 36/SR 4 and Milford Avenue meet at a 4-leg intersection, with Payne Road forming the fourth leg of the intersection. The intersection currently operates under stop-control, with Milford Avenue and Payne Road traffic stopping for US 36/SR 4. All roads in the study area are 2-lane facilities and no turn lanes are present at this location. However, a one-way slip ramp from northbound US 36/SR 4 to Milford Avenue does exist. There is a committed project to construct a westbound left turn lane on Milford Avenue at the US 36/SR 4 & Milford Avenue intersection, due to the new school building nearby.

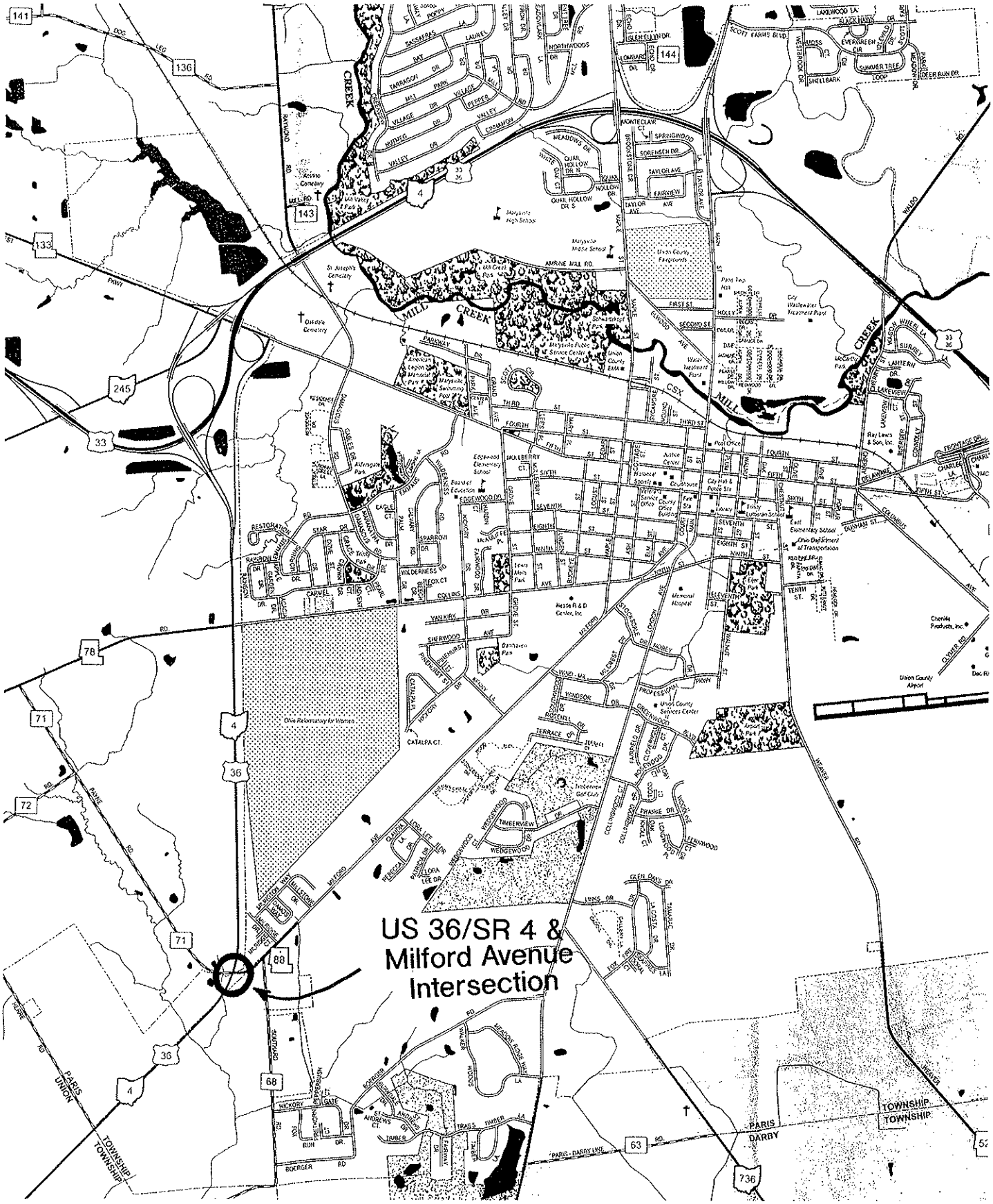
Schools

The US 36/SR 4/Milford Avenue intersection is located near the site of current and future school buildings. This school site is located on the east side of US 36/SR 4, just south of the Milford Avenue intersection. A combined intermediate/middle school (Bunsold) has already been constructed and opened for the 2008-09 school year. Two other buildings, a high school and either an elementary school or another intermediate school, have been proposed for construction by 2016. For the purposes of this study, it assumed that this third building will be an elementary school. **Figure 2** shows the conceptual layout of the Bunsold intermediate/middle school that has already opened. **Figure 3** shows the conceptual layout of the entire proposed site, including the high school and elementary school. Southbound left turn lanes on US 36/SR 4 have been committed at each of the school access drives.

Traffic Volumes

Turning movement counts were taken at the US 36/SR 4 & Milford Avenue intersection on May 22, 2008. These counts were taken during AM and PM school peak hours (7:15-8:15 AM and 2:30-3:30 PM). A copy of the raw count data can be found in the **Appendix**. The resulting count data was then multiplied by the appropriate ODOT seasonal adjustment factor (0.904) to represent an average weekday peak hour.

Figure 1: Study Location



Marysville Exempted Village School District

New Intermediate & Middle School

Proposed Site Plan

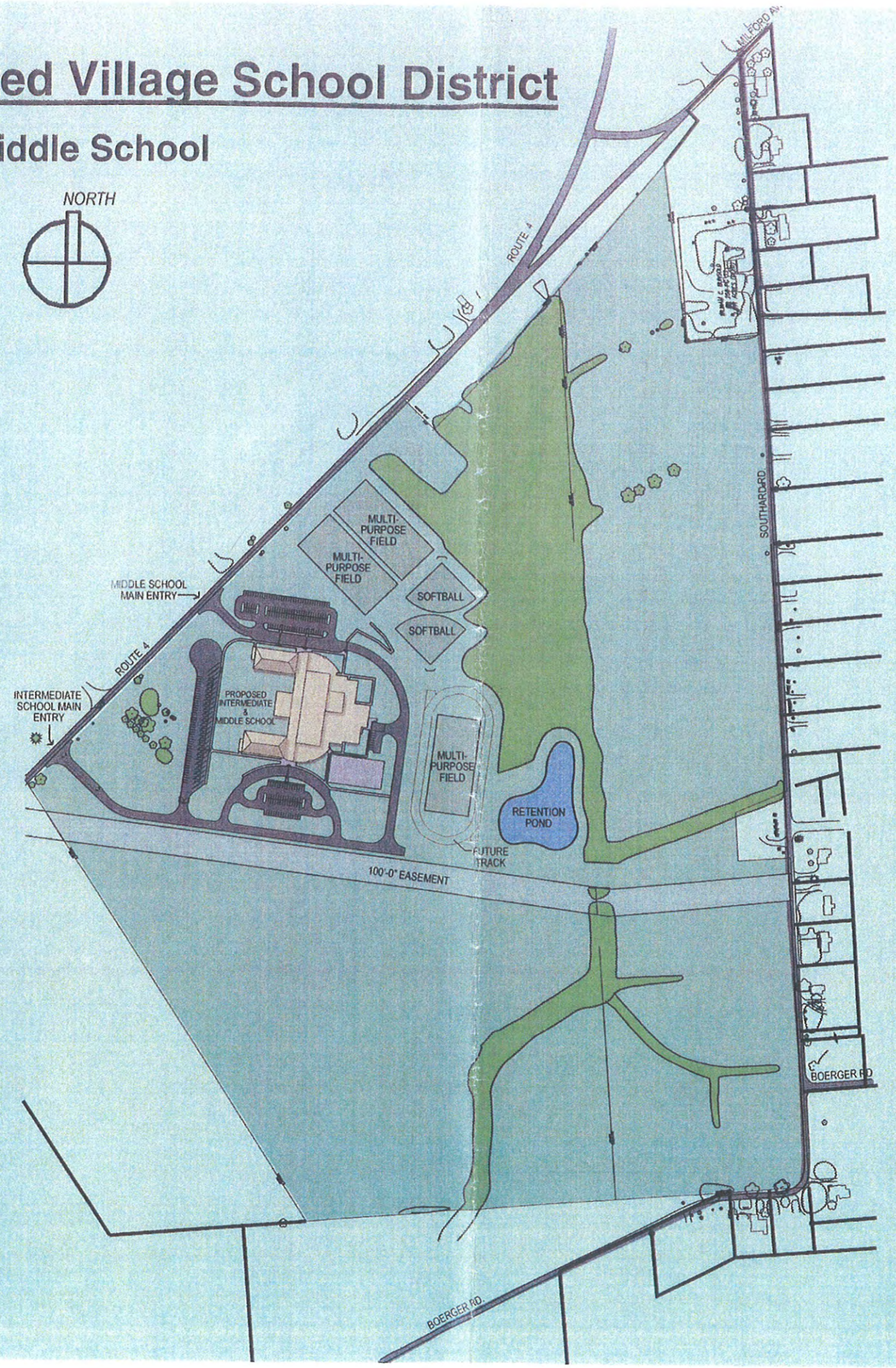


Figure 2

Marysville Exempted Village School District

Future Development – *Year 2016*

Proposed Future Site Plan

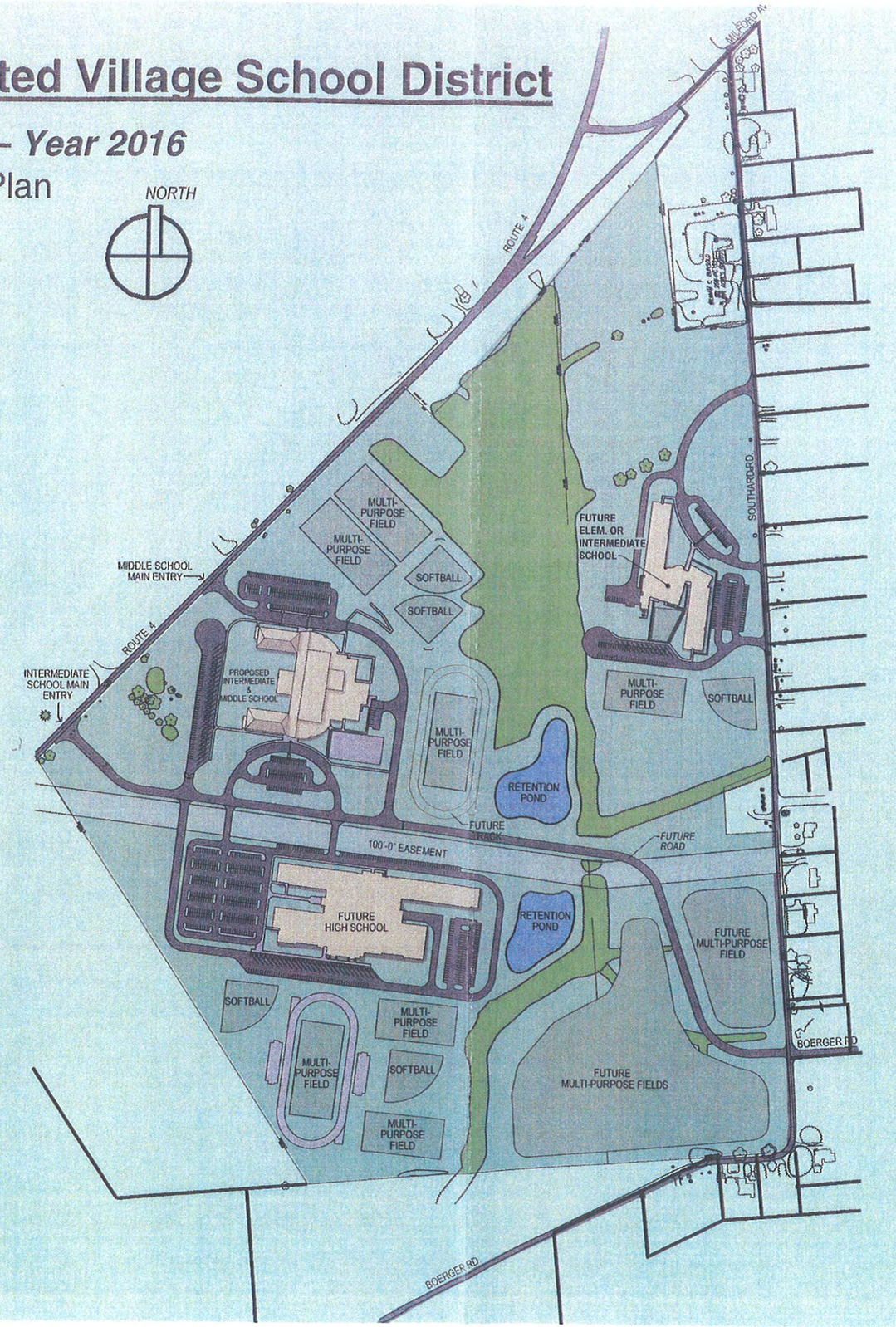


Figure 3

Trips were generated for the schools using the *ITE Trip Generation* manual. According to the Marysville Exempted Village Schools website, over 850 students are attending the new Bunsold Intermediate/Middle School. **Table 1** and **Table 2** show the trips generated during school peak hours for the short-term condition (only the Intermediate/Middle school open).

Table 1: AM School Peak Hour Trip Generation – Short-Term Condition

ITE Trip Generation Land Use Information		# of Units or Size	Trip Ends AM Peak Hour		
Code	Description		Enter	Exit	Total
522	Middle School	850 students	247	203	450
TOTAL NEW TRIPS			**247**	**203**	**450**

Table 2: PM School Peak Hour Trip Generation – Short-Term Condition

ITE Trip Generation Land Use Information		# of Units or Size	Trip Ends PM Peak Hour		
Code	Description		Enter	Exit	Total
522	Middle School	850 students	115	140	255
TOTAL NEW TRIPS			**115**	**140**	**255**

The trip generation for the Bunsold Intermediate/Middle school was added to the background traffic volumes according to the distribution shown in **Table 1**. This distribution was developed for the Bunsold Intermediate/Middle School in an August 4, 2006 study by Kleingers & Associates. The resulting 2008 AM and PM school peak hour volumes are shown on **Figure 4**.

Table 3: School Traffic Distribution

To/from the south on US 36/SR 4	0 %
To/from the north of US 36/SR 4	55 %
To/from the northeast on Milford Avenue	45 %*
To/from the west on Payne Road	0 %

*5% of this volume is assumed to use the proposed access drive to Southard Road in the 2028 analysis

The year 2028 will be used in this study for the purposes of making long-term recommendations. Based on ODOT historic count data, a linear growth rate of 1% per year was assumed for this intersection, except for the southbound left turn and westbound right turn, for which a 3% annual growth rate was used. (The count data indicated this

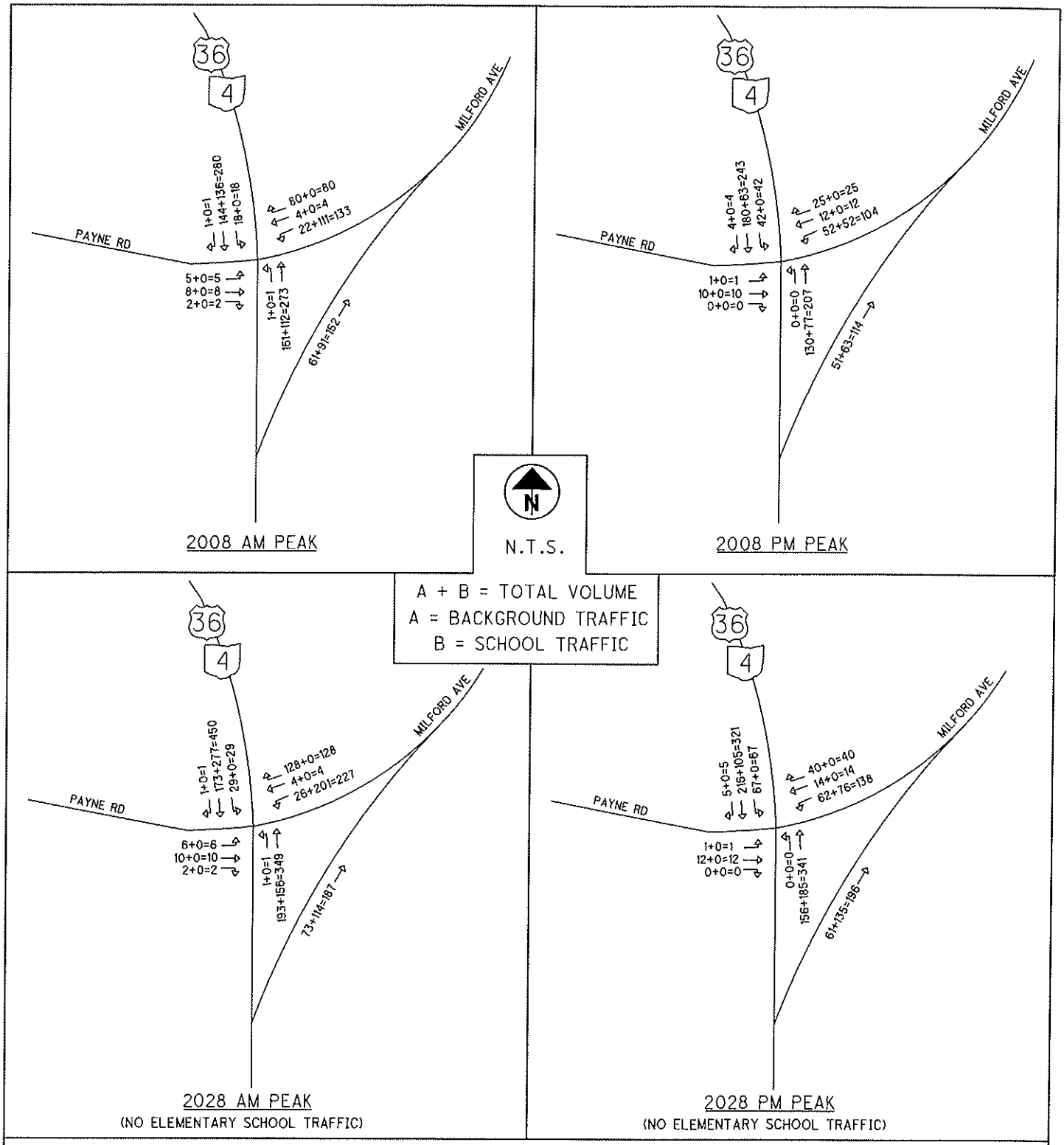


Figure 4

US 36/SR 4 & MILFORD AVENUE TRAFFIC VOLUMES

Marysville, OH

Prepared by

MS CONSULTANTS, INC.

higher growth rate on the north and east legs of the intersection.) These growth rates were applied to the background traffic data. It is assumed that all three schools will be built and open to students by 2028. Due to the cursory nature of this analysis, and the fact that the two proposed buildings are likely several years away from construction, trip generation was based on the average size of high schools and elementary schools. **Table 4** and **Table 5** show trip generation for all three proposed schools. However, it is assumed that the elementary school would not start or dismiss during the same hours as the other two buildings. Therefore, the trips from the elementary school have not been included in the 2028 AM and PM school peak hour volumes shown on Figure 4.

Table 4: AM School Peak Hour Trip Generation – Full Campus Buildout

ITE Trip Generation Land Use Information		# of Units or Size	Trip Ends AM Peak Hour		
Code	Description		Enter	Exit	Total
522	Middle School	550 students*	161	131	292
530	High School	1,290 students	342	153	495
SUBTOTAL			*503*	*284*	*787*
520	Elementary School	620 students	143	117	260
TOTAL NEW TRIPS			**646**	**401**	**1047**

*assumes that Middle School and Intermediate School have start/dismissal times one hour apart.

Table 5: PM School Peak Hour Trip Generation – Full Campus Buildout

ITE Trip Generation Land Use Information		# of Units or Size	Trip Ends PM Peak Hour		
Code	Description		Enter	Exit	Total
522	Middle School	550 students*	74	91	165
530	High School	1,290 students	116	246	362
SUBTOTAL			*190*	*337*	*527*
520	Elementary School	620 students	78	96	174
TOTAL NEW TRIPS			**268**	**433**	**701**

*assumes that Middle School and Intermediate School have start/dismissal times one hour apart.

The Bunsold Intermediate/Middle School building is expected to eventually contain 1,100 students. In the previous Kleingers study, it was assumed that the building would function as two independent schools, with either the intermediate school or the middle school opening and dismissing one hour ahead of the other school. Therefore, trips were generated in Table 4 and Table 5 assuming that only half (550) of the students arrive and leave during the same peak hour as the high school.

Crash Data

The City of Marysville provided crash data for the three-year period from 2005-2007. Four crashes occurred in the vicinity of the US 36/SR 4 & Milford Avenue intersection. Two crashes took place at the intersection – one angle collision, and one collision caused by improper passing. Based on the available data, no discernable pattern of crashes is occurring at this intersection.

Short-Term Analysis

Due to concerns regarding inbound school traffic making unsignalized left turns onto the high-speed US 36/SR 4 from Milford Avenue, a signal may be desirable at this intersection. Based on the volumes developed for 2008, a preliminary signal warrant analysis was conducted for the US 36/SR 4 & Milford Avenue intersection. Because only two hours of traffic count data have been collected, a full signal warrant analysis cannot be conducted. However, the peak hour traffic volumes have been compared with the volume requirements listed in the Ohio Manual of Uniform Traffic Control Devices (OMUTCD) for Warrant 1 (Eight-Hour Volume), Warrant 2 (Four-Hour Volume), and Warrant 3 (Peak Hour Volume) to estimate whether a signal may be warranted. **Table 6** shows that Warrant 1 would not be met, because neither of the peak hours contains the volumes required in the eighth-highest hour of the day. School-related traffic was not included in this analysis, as the school volumes present in the peak hours would not be present during each of the eight highest hours of the day. Because US 36/SR 4 has a 55-mph speed limit in the study area, the high-speed warrant criteria are shown in Table 6.

Table 6: Preliminary Findings for Warrant 1

	Sum of Major Street Volume		Highest Minor Street Volume	
	2008 Non-school Volumes	Volumes Needed for Warrant	2008 Non-School Volumes	Volumes Needed for Warrant
Warrant 1A (Eight-Hour)	325 AM 356 PM	350 in each of 8 hours	106 AM 89 PM	105 in each of 8 hours
Warrant 1B (Eight-Hour)	325 AM 356 PM	525 in each of 8 hours	106 AM 89 PM	53 in each of 8 hours

The OMUTCD contains graphs for evaluating Warrant 2 and Warrant 3. The 2008 peak hour volumes have been plotted on these charts, which are included in the Appendix. As with the Eight-Hour warrant, school-related traffic was excluded from the Four-Hour warrant volumes because school traffic would not be occurring outside of the two school peak hours. The graphs show that the Four-Hour warrant would not be met, as the peak hour volume is less than the volume required in the fourth-highest hour of the day. However, based on the peak hour volumes in Figure 4, it appears that the Peak Hour Warrant (Warrant 3) would be met. (School traffic was included in the Peak Hour Warrant analysis.) Now that the Bunsold Intermediate/Middle School is open, a count during school peak hours would be needed to verify that the warrant is actually met. Because only the peak hour warrant is likely to be met, if a signal were installed, it should be in red-yellow-green cycling operation during school peak hours. A signal installed on the peak hour warrant should be in flash-mode except during peak hours.

Capacity analyses for 2008 volumes have been performed using Highway Capacity Software (HCS+). **Table 7** shows that the US 36/SR 4 intersection with Milford Avenue currently operates at level-of-service (LOS) C during both school peak hours.

Installation of a signal would result in LOS B operations. The committed westbound left turn lane on Milford Avenue has been assumed to exist in all analyses. Copies of all HCS reports have been included in the Appendix.

Table 7: 2008 HCS Levels-of-Service and Average Vehicle Delays (in seconds)

	Unsignalized*	Signalized
AM School Peak	C 17.6	B 11.1
PM School Peak	C 16.4	B 10.8

*delays shown for the Unsignalized condition are for the worst stopped approach.

The school campus future plans show that an access road is planned to be constructed to Southard Road from the middle school and high school sites. This access road, if constructed, would allow Milford Avenue traffic to get to the middle school and future high school without having to turn onto US 36/SR 4. If a signal is not installed at the US 36/SR 4 & Milford Avenue intersection, efforts should be made to construct this access road earlier than planned, thus limiting the amount of school traffic that must make the unsignalized left turn onto the 55-mph US 36/SR 4 roadway from Milford Avenue.

Long-Term Analysis

The 2028 volumes from Figure 4 were analyzed using HCS to help determine long-term recommendations for the study area. The HCS results are shown in **Table 8**. The analyses show that the US 36/SR 4 intersection will degrade to LOS F if a signal is not installed. Installation of a signal will allow the intersection to operate at LOS B during both school peak hours. Because the predicted levels-of-service are very good, it is reasonable to assume that the proposed high school and elementary school could serve much larger numbers of students (average-sized schools were used in the trip generation) without degrading the roadway network to unacceptable (LOS E or worse) operations.

Table 8: 2028 HCS Levels-of-Service and Average Vehicle Delays (in seconds)

	Unsignalized*	Signalized	Signalized with turn lanes**
AM School Peak	F 103.2	B 12.9	B 11.9
PM School Peak	E 36.0	B 11.0	B 10.6

*delays shown for the unsignalized condition are for the worst stopped approach.
*analysis includes NBLT, SBLT, and NBRT lanes are constructed (in addition to committed WBLTL, which is included in all analyses).

While the intersection is shown to operate at a very good level-of-service through 2028 by only adding a signal, it is usually not desirable to install a signal without left turn lanes. Particularly on a high-speed roadway like US 36/SR 4, signalized intersections without left turn lanes can lead to rear-end crashes. Though it was not a part of volumes in Figure 4, the elementary school will generate many southbound left turns at this intersection, including school buses. Given the relatively wide public right-of-way that exists at this intersection, northbound and southbound left turn lanes could be constructed without acquisition of land from adjacent property owners. A westbound left turn lane on Milford Avenue is already committed to be built in conjunction with the Bunsold Intermediate School. An eastbound left turn lane on Payne Road should also be considered if traffic volumes increase on this roadway.

Another possible item for improvement concerns the existing slip ramp for northbound right turn traffic. The slip ramp creates a situation where southbound left turn and eastbound through traffic must merge with the slip ramp traffic. Because the slip ramp is a tangent section of roadway, vehicles coming from the 55-mph section of US 36/SR 4 often continue their high rate of speed onto Milford Avenue. As traffic volumes at this intersection continue to increase, it would be desirable to eliminate the slip ramp. A northbound right turn lane could be installed at the intersection to provide for efficient flow of this relatively heavy turning movement. Although HCS analyses show that the intersection can operate effectively without the right turn lane, during the high school dismissal, there is likely to be a very high concentration of vehicles trying to make the northbound right turn movement.

Upon the completion of the proposed elementary school, Southard Road will see a substantial increase in traffic. According to the previous Kleingers study, approximately 50 vehicles currently use Southard Road during the peak hour. The opening of a new school on Southard Road would generate over 200 trips during the school peak hour. Construction of an access road connecting Southard Road to the existing middle school and future high school would also cause increased traffic volumes on Southard Road. The existing pavement may not be designed to accommodate such traffic volumes, particularly school buses. Improvements to Southard Road may be necessary when the elementary school is constructed or the access road is built. A southwest-bound left turn lane on Milford Avenue could be warranted at that time. Sidewalks and/or bicycle paths should be constructed along Southard Road and Milford Avenue to provide connections into nearby neighborhoods, and prevent pedestrians from walking in the street.

Recommendations

The following bullet points summarize the findings of this document. Recommendations are included for short-term and long-term improvements in the vicinity of the US 36/SR 4 & Milford Avenue intersection.

Short-Term

- A peak hour signal warrant is likely met at the US 36/SR 4 & Milford Avenue intersection.
    - A formal signal warrant study should be undertaken to verify this possibility
    - If installed based on peak hour warrant, signal should operate in flash-mode outside of school peak hours
- If a signal is not installed, the proposed access road from the middle/high school sites to Southard Road should be constructed as soon as possible.

Long-Term

- A signal will be necessary at the US 36/SR 4 & Milford Avenue intersection to avoid failing traffic operations during school peak hours
- Left turn lanes should be provided on all the northbound and southbound approaches to the US 36/SR 4 & Milford Avenue intersection
- An eastbound left turn lane on Payne Road should be considered if traffic volumes increase on this approach
- A southwest-bound left turn lane should be considered on Milford Avenue at Southard Road if either of the following occurs:
    - the proposed elementary school is constructed
    - a signal is not in place at US 36/SR 4 & Milford Avenue, and the access road from the middle/high school sites to Southard Road is constructed
- Southard Road may need to be improved if the existing roadway cannot support the increased traffic volumes from the elementary school and/or the proposed access road between Southard Road and the middle school and proposed high school
- Sidewalks and/or bicycle paths should be constructed along Southard Road and Milford Avenue to provide access from the schools to adjacent neighborhoods.

Appendix

Other Relevant Documentation

ms consultants, inc.
2221 Schrock Road
Columbus, OH 43229

Marysville Traffic Study
Marysville, OH
Weekday Peak Hours

File Name : SR4 Milford
Site Code : 00000000
Start Date : 5/22/2008
Page No : 1

Groups Printed- Passenger Cars - Trucks

	MILFORD AVE Eastbound					MILFORD AVE Westbound					RT 4 Northbound					RT 4 Southbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Factor	1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		
07:15 AM	1	2	0	0	3	6	1	27	0	34	0	51	9	0	60	4	39	0	0	43	140
07:30 AM	0	0	1	0	1	8	1	20	0	29	1	47	17	0	65	4	37	0	0	41	136
07:45 AM	0	5	1	0	6	6	0	19	0	25	0	44	26	0	70	10	44	0	0	54	155
Total	1	7	2	0	10	20	2	66	0	88	1	142	52	0	195	18	120	0	0	138	431
08:00 AM	4	2	0	0	6	4	2	23	0	29	0	36	9	0	45	2	39	1	1	43	123
Total	4	2	0	0	6	4	2	23	0	29	0	36	9	0	45	2	39	1	1	43	123
02:30 PM	0	2	0	0	2	7	2	4	0	13	0	33	14	0	47	6	40	0	0	46	108
02:45 PM	1	3	0	0	4	16	5	8	0	29	0	43	15	0	58	17	47	1	0	65	156
Total	1	5	0	0	6	23	7	12	0	42	0	76	29	0	105	23	87	1	0	111	264
03:00 PM	0	4	0	0	4	22	3	8	0	33	0	33	12	0	45	11	60	2	0	73	155
03:15 PM	0	2	0	0	2	12	3	8	0	23	0	35	10	0	45	13	52	1	0	66	136
Grand Total	6	20	2	0	28	81	17	117	0	215	1	322	112	0	435	67	358	5	1	431	1109
Apprch %	21.4	71.4	7.1	0.0		37.7	7.9	54.4	0.0		0.2	74.0	25.7	0.0		15.5	83.1	1.2	0.2		
Total %	0.5	1.8	0.2	0.0	2.5	7.3	1.5	10.6	0.0	19.4	0.1	29.0	10.1	0.0	39.2	6.0	32.3	0.5	0.1	38.9	

TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	*REB*	Intersection	*US 36/SR 4 & Milford Ave.*
Agency/Co.	*ms consultants*	Jurisdiction	*Marysville, OH*
Date Performed	*10/2/2008*	Analysis Year	*2008*
Analysis Time Period	*AM Peak Hour*		

Project Description

East/West Street: *Milford Avenue*	North/South Street: *US 36/SR 4*
Intersection Orientation: *North-South*	Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	*1*	*273*		*18*	*280*	*1*
Peak-Hour Factor, PHF	*0.90*	*0.90*	*1.00*	*0.90*	*0.90*	*0.90*
Hourly Flow Rate, HFR (veh/h)	*1*	*303*	*0*	*20*	*311*	*1*
Percent Heavy Vehicles	*4*	--	--	*4*	--	--
Median Type	*Undivided*					
RT Channelized			*0*			*0*
Lanes	*0*	*1*	*0*	*0*	*1*	*0*
Configuration	*LT*			*LTR*		
Upstream Signal		*0*			*0*	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	*5*	*8*	*2*	*133*	*4*	*80*
Peak-Hour Factor, PHF	*0.90*	*0.90*	*0.90*	*0.90*	*0.90*	*0.90*
Hourly Flow Rate, HFR (veh/h)	*5*	*8*	*2*	*147*	*4*	*88*
Percent Heavy Vehicles	*4*	*4*	*4*	*4*	*4*	*4*
Percent Grade (%)		*0*			*0*	
Flared Approach		*N*			*N*	
Storage		*0*			*0*	
RT Channelized			*0*			*0*
Lanes	*0*	*1*	*0*	*1*	*1*	*0*
Configuration		*LTR*		*L*		*TR*

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	*LT*	*LTR*	*L*		*TR*		*LTR*	
v (veh/h)	*1*	*20*	*147*		*92*		*15*	
C (m) (veh/h)	*1237*	*1247*	*360*		*703*		*368*	
v/c	*0.00*	*0.02*	*0.41*		*0.13*		*0.04*	
95% queue length	*0.00*	*0.05*	*1.93*		*0.45*		*0.13*	
Control Delay (s/veh)	*7.9*	*7.9*	*21.7*		*10.9*		*15.2*	
LOS	*A*	*A*	*C*		*B*		*C*	
Approach Delay (s/veh)	--	--	*17.6*			*15.2*		
Approach LOS	--	--	*C*			*C*		

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	*REB*	Intersection	*US 36/SR 4 & Milford Ave.*
Agency/Co.	*ms consultants*	Jurisdiction	*Marysville, OH*
Date Performed	*10/2/2008*	Analysis Year	*2008*
Analysis Time Period	*PM Peak Hour*		

Project Description

East/West Street: *Milford Avenue*	North/South Street: *US 36/SR 4*
Intersection Orientation: *North-South*	Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	0	207		42	243	4
Peak-Hour Factor, PHF	0.90	0.90	1.00	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	0	230	0	46	270	4
Percent Heavy Vehicles	4	--	--	4	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	1	0	0	1	0
Configuration	LT			LTR		
Upstream Signal		0			0	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	1	10	0	104	12	25
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	1	11	0	115	13	27
Percent Heavy Vehicles	4	4	4	4	4	4
Percent Grade (%)		0			0	
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	0	1	0	1	1	0
Configuration		LTR		L		TR

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	LT	LTR	L		TR		LTR	
v (veh/h)	0	46	115		40		12	
C (m) (veh/h)	1278	1326	389		603		395	
v/c	0.00	0.03	0.30		0.07		0.03	
95% queue length	0.00	0.11	1.22		0.21		0.09	
Control Delay (s/veh)	7.8	7.8	18.1		11.4		14.4	
LOS	A	A	C		B		B	
Approach Delay (s/veh)	--	--	16.4			14.4		
Approach LOS	--	--	C			B		

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HCS+: Signalized Intersections Release 5.3

Analyst: REB
Agency: ms consultants
Date: 9/3/2008
Period: AM Peak Hour
Project ID: with signal
E/W St: Milford Avenue

Inter.: SR 4 & Milford Ave.
Area Type: All other areas
Jurisd: Marysville, OH
Year : 2008

N/S St: US 36/SR 4

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	1	1	0	0	1	0	0	1	0
LGConfig		LTR		L	TR			LT			LTR	
Volume	5	8	2	133	4	80	1	273		18	280	1
Lane Width		12.0		12.0	12.0			12.0			12.0	
RTOR Vol			0			0						0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4			5	6	7	8
EB Left	A				NB	Left	P			
Thru	A					Thru	P			
Right	A					Right	P			
Peds						Peds				
WB Left	A				SB	Left	P			
Thru	A					Thru	P			
Right	A					Right	P			
Peds						Peds				
NB Right					EB	Right				
SB Right					WB	Right				
Green	23.0						27.0			
Yellow	4.0						4.0			
All Red	1.0						1.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
LTR	702	1686	0.02	0.42	10.3	B	10.3	B
Westbound								
L	563	1351	0.26	0.42	11.7	B		
TR	646	1550	0.14	0.42	11.0	B	11.4	B
Northbound								
LT	874	1808	0.35	0.48	10.7	B	10.7	B
Southbound								
LTR	852	1763	0.39	0.48	11.2	B	11.2	B

Intersection Delay = 11.1 (sec/veh) Intersection LOS = B

HCS+: Signalized Intersections Release 5.3

Analyst: REB
Agency: ms consultants
Date: 9/3/2008
Period: PM Peak Hour
Project ID: with signal
E/W St: Milford Avenue

Inter.: SR 4 & Milford Ave.
Area Type: All other areas
Jurisd: Marysville, OH
Year : 2008

N/S St: US 36/SR 4

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	1	1	0	0	1	0	0	1	0
LGConfig		LTR		L	TR			LT			LTR	
Volume	1	10	0	104	12	25	0	207		42	243	4
Lane Width		12.0		12.0	12.0			12.0			12.0	
RTOR Vol			0			0						0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4			5	6	7	8
EB	Left	A				NB	Left	P			
	Thru	A					Thru	P			
	Right	A					Right	P			
	Peds						Peds				
WB	Left	A				SB	Left	P			
	Thru	A					Thru	P			
	Right	A					Right	P			
	Peds						Peds				
NB	Right					EB	Right				
SB	Right					WB	Right				
Green		23.0						27.0			
Yellow		4.0						4.0			
All Red		1.0						1.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
LTR	747	1794	0.02	0.42	10.3	B	10.3	B
Westbound								
L	565	1357	0.21	0.42	11.3	B		
TR	677	1624	0.06	0.42	10.5	B	11.1	B
Northbound								
LT	875	1810	0.26	0.48	9.9	A	9.9	A
Southbound								
LTR	816	1689	0.39	0.48	11.3	B	11.3	B

Intersection Delay = 10.8 (sec/veh) Intersection LOS = B

TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	*REB*	Intersection	*US 36/SR 4 & Milford Ave.*
Agency/Co.	*ms consultants*	Jurisdiction	*Marysville, OH*
Date Performed	*10/2/2008*	Analysis Year	*2028*
Analysis Time Period	*AM Peak Hour*		

Project Description

East/West Street: *Milford Avenue*	North/South Street: *US 36/SR 4*
Intersection Orientation: *North-South*	Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	*1*	*349*		*29*	*450*	*1*
Peak-Hour Factor, PHF	*0.90*	*0.90*	*1.00*	*0.90*	*0.90*	*0.90*
Hourly Flow Rate, HFR (veh/h)	*1*	*387*	*0*	*32*	*500*	*1*
Percent Heavy Vehicles	*4*	--	--	*4*	--	--
Median Type	*Undivided*					
RT Channelized			*0*			*0*
Lanes	*0*	*1*	*0*	*0*	*1*	*0*
Configuration	*LT*			*LTR*		
Upstream Signal		*0*			*0*	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	*6*	*10*	*2*	*227*	*4*	*128*
Peak-Hour Factor, PHF	*0.90*	*0.90*	*0.90*	*0.90*	*0.90*	*0.90*
Hourly Flow Rate, HFR (veh/h)	*6*	*11*	*2*	*252*	*4*	*142*
Percent Heavy Vehicles	*4*	*4*	*4*	*4*	*4*	*4*
Percent Grade (%)		*0*			*0*	
Flared Approach		*N*			*N*	
Storage		*0*			*0*	
RT Channelized			*0*			*0*
Lanes	*0*	*1*	*0*	*1*	*1*	*0*
Configuration		*LTR*		*L*		*TR*

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	*LT*	*LTR*	*L*		*TR*		*LTR*	
v (veh/h)	*1*	*32*	*252*		*146*		*19*	
C (m) (veh/h)	*1053*	*1161*	*218*		*628*		*221*	
v/c	*0.00*	*0.03*	*1.16*		*0.23*		*0.09*	
95% queue length	*0.00*	*0.08*	*12.08*		*0.90*		*0.28*	
Control Delay (s/veh)	*8.4*	*8.2*	*155.7*		*12.5*		*22.8*	
LOS	*A*	*A*	*F*		*B*		*C*	
Approach Delay (s/veh)	--	--	*103.2*			*22.8*		
Approach LOS	--	--	*F*			*C*		

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	*REB*	Intersection	*US 36/SR 4 & Milford Ave.*
Agency/Co.	*ms consultants*	Jurisdiction	*Marysville, OH*
Date Performed	*10/2/2008*	Analysis Year	*2028*
Analysis Time Period	*PM Peak Hour*		

Project Description

East/West Street: *Milford Avenue*	North/South Street: *US 36/SR 4*
Intersection Orientation: *North-South*	Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	0	341		67	321	5
Peak-Hour Factor, PHF	0.90	0.90	1.00	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	0	378	0	74	356	5
Percent Heavy Vehicles	4	--	--	4	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	1	0	0	1	0
Configuration	LT			LTR		
Upstream Signal		0			0	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	1	12	0	138	14	40
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	1	13	0	153	15	44
Percent Heavy Vehicles	4	4	4	4	4	4
Percent Grade (%)		0			0	
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	0	1	0	1	1	0
Configuration		LTR		L		TR

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	LT	LTR	L		TR		LTR	
v (veh/h)	0	74	153		59		14	
C (m) (veh/h)	1187	1170	236		474		255	
v/c	0.00	0.06	0.65		0.12		0.05	
95% queue length	0.00	0.20	3.99		0.42		0.17	
Control Delay (s/veh)	8.0	8.3	44.6		13.7		19.9	
LOS	A	A	E		B		C	
Approach Delay (s/veh)	--	--	36.0			19.9		
Approach LOS	--	--	E			C		

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HCS+: Signalized Intersections Release 5.3

Analyst: REB
Agency: ms consultants
Date: 9/3/2008
Period: AM Peak Hour
Project ID: with signal only
E/W St: Milford Avenue

Inter.: SR 4 & Milford Ave.
Area Type: All other areas
Jurisd: Marysville, OH
Year : 2028

N/S St: US 36/SR 4

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	1	1	0	0	1	0	0	1	0
LGConfig		LTR		L	TR			LT			LTR	
Volume	6	10	2	227	4	128	1	349		29	450	1
Lane Width		12.0		12.0	12.0			12.0			12.0	
RTOR Vol			0			0						0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4			5	6	7	8
EB	Left	A				NB	Left	P			
	Thru	A					Thru	P			
	Right	A					Right	P			
	Peds						Peds				
WB	Left	A				SB	Left	P			
	Thru	A					Thru	P			
	Right	A					Right	P			
	Peds						Peds				
NB	Right					EB	Right				
SB	Right					WB	Right				
Green		22.0						28.0			
Yellow		4.0						4.0			
All Red		1.0						1.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
LTR	668	1671	0.03	0.40	10.9	B	10.9	B
Westbound								
L	539	1347	0.47	0.40	13.9	B		
TR	618	1546	0.24	0.40	12.1	B	13.3	B
Northbound								
LT	904	1808	0.43	0.50	11.1	B	11.1	B
Southbound								
LTR	874	1747	0.61	0.50	14.0	B	14.0	B

Intersection Delay = 12.9 (sec/veh) Intersection LOS = B

HCS+: Signalized Intersections Release 5.3

Analyst: REB
Agency: ms consultants
Date: 9/3/2008
Period: PM Peak Hour
Project ID: with signal only
E/W St: Milford Avenue

Inter.: SR 4 & Milford Ave.
Area Type: All other areas
Jurisd: Marysville, OH
Year : 2028

N/S St: US 36/SR 4

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	1	1	0	0	1	0	0	1	0
LGConfig		LTR		L	TR			LTR			LTR	
Volume	1	10	0	104	12	25	0	207	114	42	243	4
Lane Width		12.0		12.0	12.0			12.0			12.0	
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4			5	6	7	8
EB	Left	A				NB	Left	P			
	Thru	A					Thru	P			
	Right	A					Right	P			
	Peds						Peds				
WB	Left	A				SB	Left	P			
	Thru	A					Thru	P			
	Right	A					Right	P			
	Peds						Peds				
NB	Right					EB	Right				
SB	Right					WB	Right				
Green		22.0						28.0			
Yellow		4.0						4.0			
All Red		1.0						1.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
LTR	718	1794	0.02	0.40	10.9	B	10.9	B
Westbound								
L	543	1357	0.21	0.40	12.0	B		
TR	650	1624	0.06	0.40	11.1	B	11.8	B
Northbound								
LTR	862	1723	0.41	0.50	10.9	B	10.9	B
Southbound								
LTR	829	1657	0.39	0.50	10.7	B	10.7	B

Intersection Delay = 11.0 (sec/veh) Intersection LOS = B

HCS+: Signalized Intersections Release 5.3

Analyst: REB
Agency: ms consultants
Date: 9/3/2008
Period: AM Peak Hour
Project ID: with signal and turn lanes
E/W St: Milford Avenue

Inter.: SR 4 & Milford Ave.
Area Type: All other areas
Jurisd: Marysville, OH
Year : 2028

N/S St: US 36/SR 4

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	0	1	1	0	1	1	1	1	1	0
LGConfig	L	TR		L	TR		L	T	R	L	TR	
Volume	6	10	2	227	4	128	1	349	187	29	450	1
Lane Width	12.0	12.0		12.0	12.0		12.0	12.0	12.0	12.0	12.0	
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4			5	6	7	8
EB	Left	A				NB	Left	P			
	Thru	A					Thru	P			
	Right	A					Right	P			
	Peds						Peds				
WB	Left	A				SB	Left	P			
	Thru	A					Thru	P			
	Right	A					Right	P			
	Peds						Peds				
NB	Right					EB	Right				
SB	Right					WB	Right				
Green		22.0						28.0			
Yellow		4.0						4.0			
All Red		1.0						1.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	477	1193	0.01	0.40	10.9	B		
TR	707	1768	0.02	0.40	10.9	B	10.9	B
Westbound								
L	542	1355	0.46	0.40	13.9	B		
TR	618	1546	0.24	0.40	12.1	B	13.2	B
Northbound								
L	310	620	0.00	0.50	7.5	A		
T	905	1810	0.43	0.50	11.0	B	10.5	B
R	769	1538	0.27	0.50	9.5	A		
Southbound								
L	398	795	0.08	0.50	8.2	A		
TR	905	1809	0.55	0.50	12.8	B	12.5	B

Intersection Delay = 11.9 (sec/veh) Intersection LOS = B

HCS+: Signalized Intersections Release 5.3

Analyst: REB
Agency: ms consultants
Date: 9/3/2008
Period: PM Peak Hour
Project ID: with signal and turn lanes
E/W St: Milford Avenue

Inter.: SR 4 & Milford Ave.
Area Type: All other areas
Jurisd: Marysville, OH
Year : 2008

N/S St: US 36/SR 4

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	0	1	1	0	1	1	1	1	1	0
LGConfig	L	TR		L	TR		L	T	R	L	TR	
Volume	1	10	0	104	12	25	0	207	114	42	243	4
Lane Width	12.0	12.0		12.0	12.0		12.0	12.0	12.0	12.0	12.0	
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4			5	6	7	8
EB	Left	A				NB	Left	P			
	Thru	A					Thru	P			
	Right	A					Right	P			
	Peds						Peds				
WB	Left	A				SB	Left	P			
	Thru	A					Thru	P			
	Right	A					Right	P			
	Peds						Peds				
NB	Right					EB	Right				
SB	Right					WB	Right				
Green		23.0						27.0			
Yellow		4.0						4.0			
All Red		1.0						1.0			

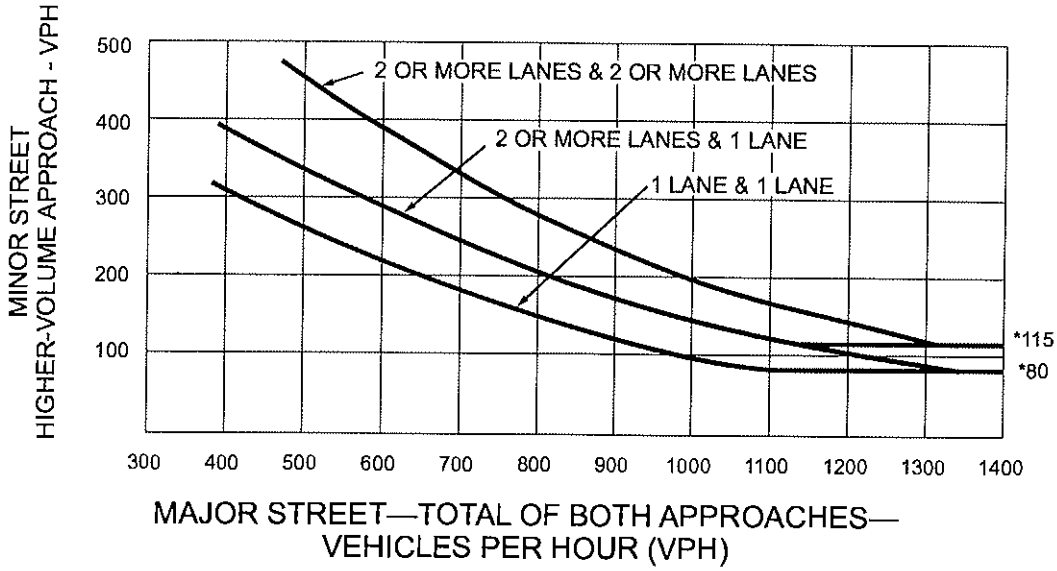
Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	507	1322	0.00	0.38	11.4	B		
TR	754	1810	0.01	0.42	10.3	B	10.4	B
Westbound								
L	521	1358	0.22	0.38	12.7	B		
TR	677	1624	0.06	0.42	10.5	B	12.1	B
Northbound								
L	471	1047	0.00	0.45	9.1	A		
T	875	1810	0.26	0.48	9.9	A	10.1	B
R	692	1538	0.18	0.45	10.5	B		
Southbound								
L	501	1113	0.09	0.45	9.8	A		
TR	873	1806	0.31	0.48	10.4	B	10.3	B

Intersection Delay = 10.6 (sec/veh) Intersection LOS = B

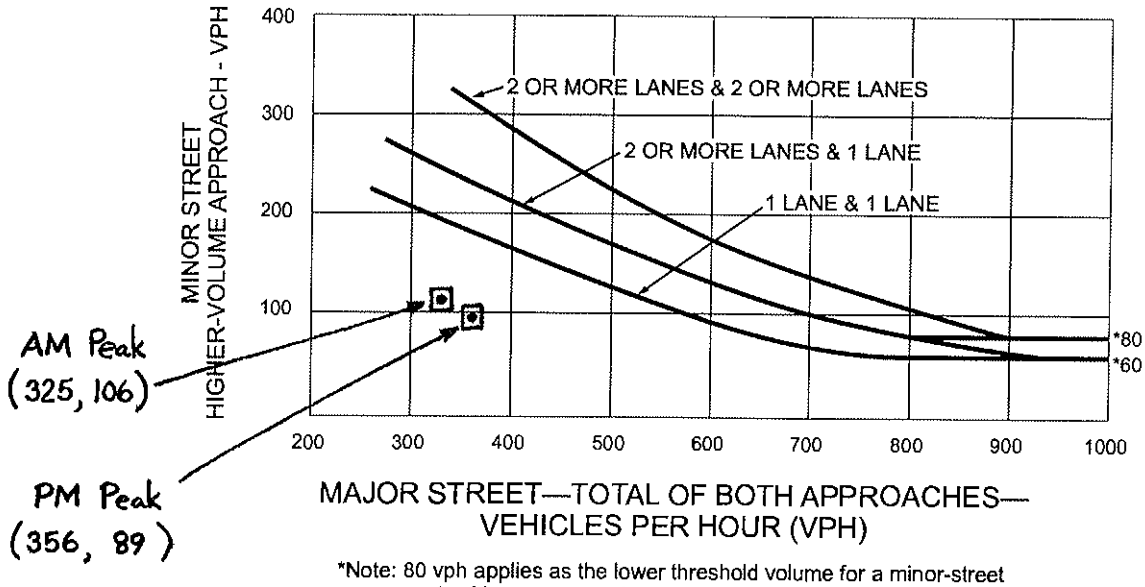
Figure 4C-1. Warrant 2, Four-Hour Vehicular Volume



*Note: 115 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 80 vph applies as the lower threshold volume for a minor-street approach with one lane.

Figure 4C-2. Warrant 2, Four-Hour Vehicular Volume (70% Factor)

(COMMUNITY LESS THAN 10,000 POPULATION OR ABOVE 70 km/h OR ABOVE 40 mph ON MAJOR STREET)



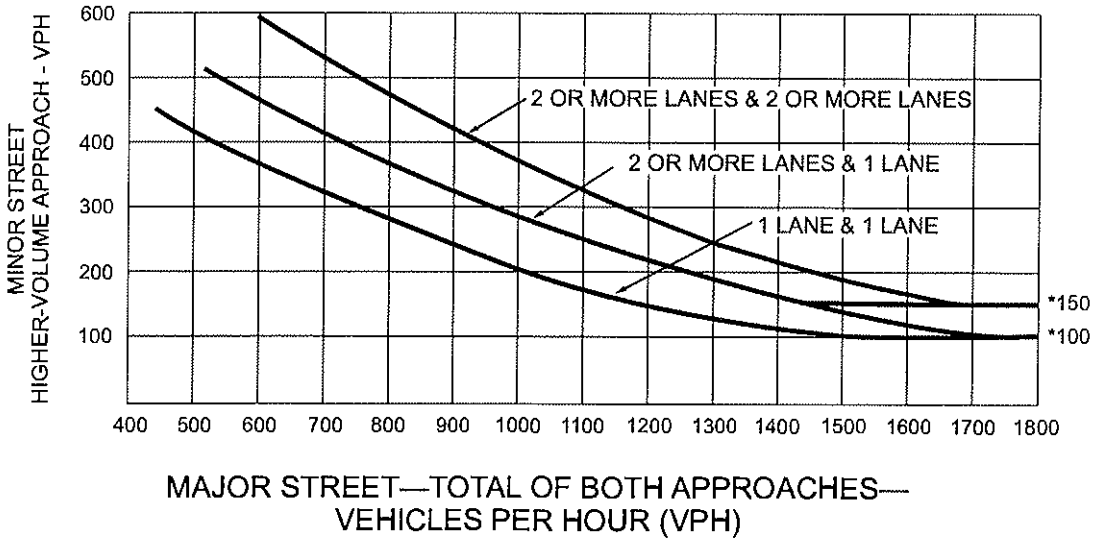
AM Peak (325, 106)

PM Peak (356, 89)

*Note: 80 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 60 vph applies as the lower threshold volume for a minor-street approach with one lane.

NOT WARRANTED

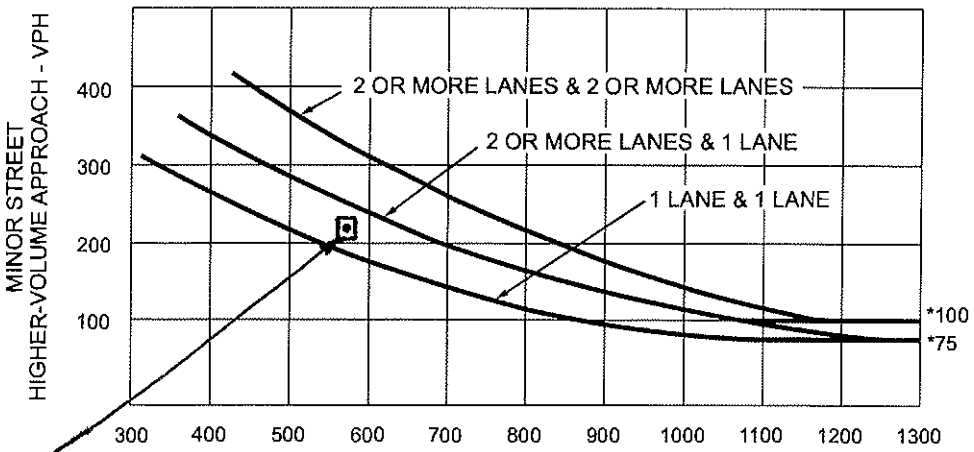
Figure 4C-3. Warrant 3, Peak Hour



*Note: 150 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 100 vph applies as the lower threshold volume for a minor-street approach with one lane.

Figure 4C-4. Warrant 3, Peak Hour (70% Factor)

(COMMUNITY LESS THAN 10,000 POPULATION OR ABOVE 70 km/h OR ABOVE 40 mph ON MAJOR STREET)



AM Peak
(573, 217)
WARRANTED

MAJOR STREET—TOTAL OF BOTH APPROACHES—
VEHICLES PER HOUR (VPH)

*Note: 100 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 75 vph applies as the lower threshold volume for a minor-street approach with one lane.

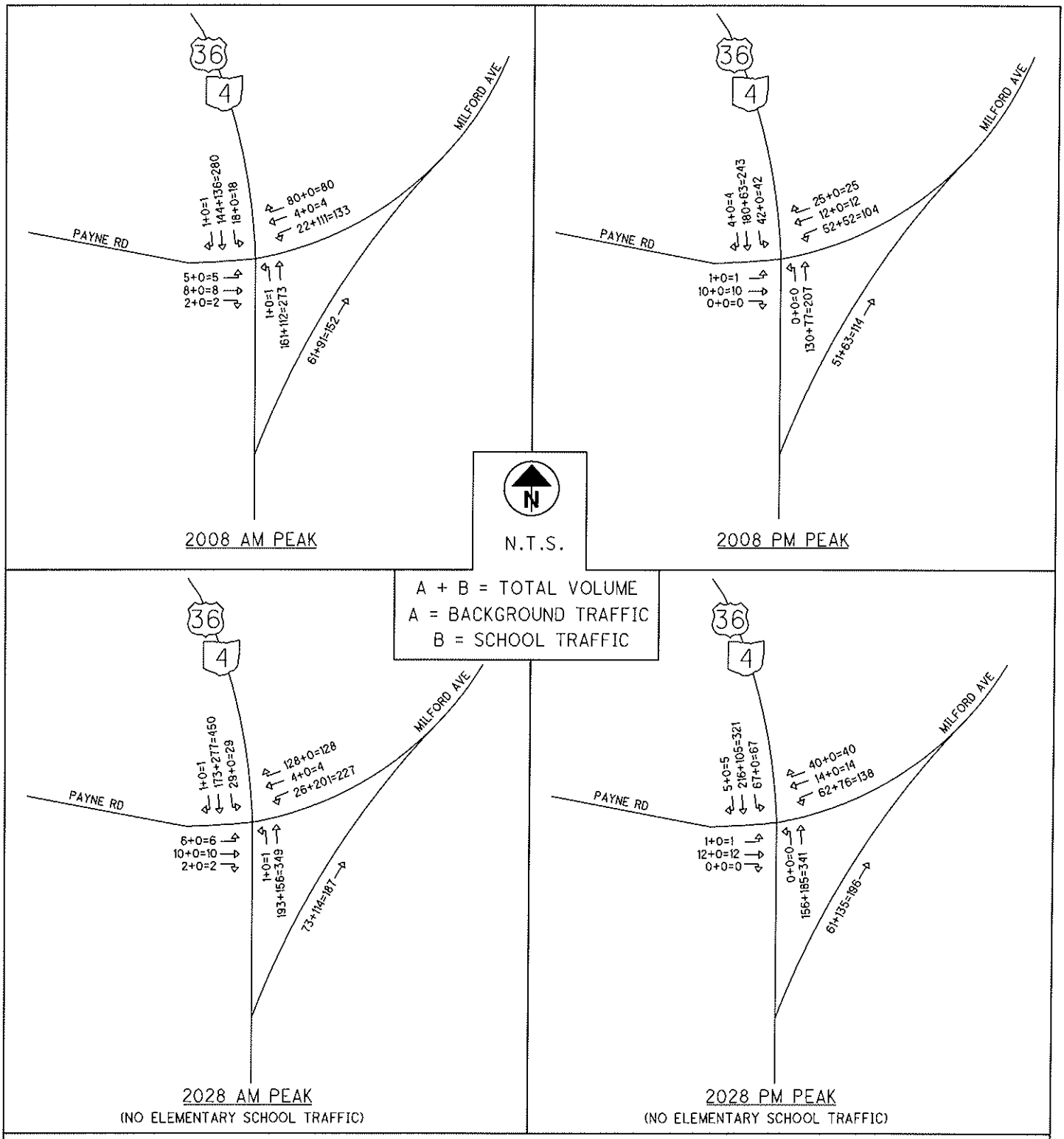


Figure 4

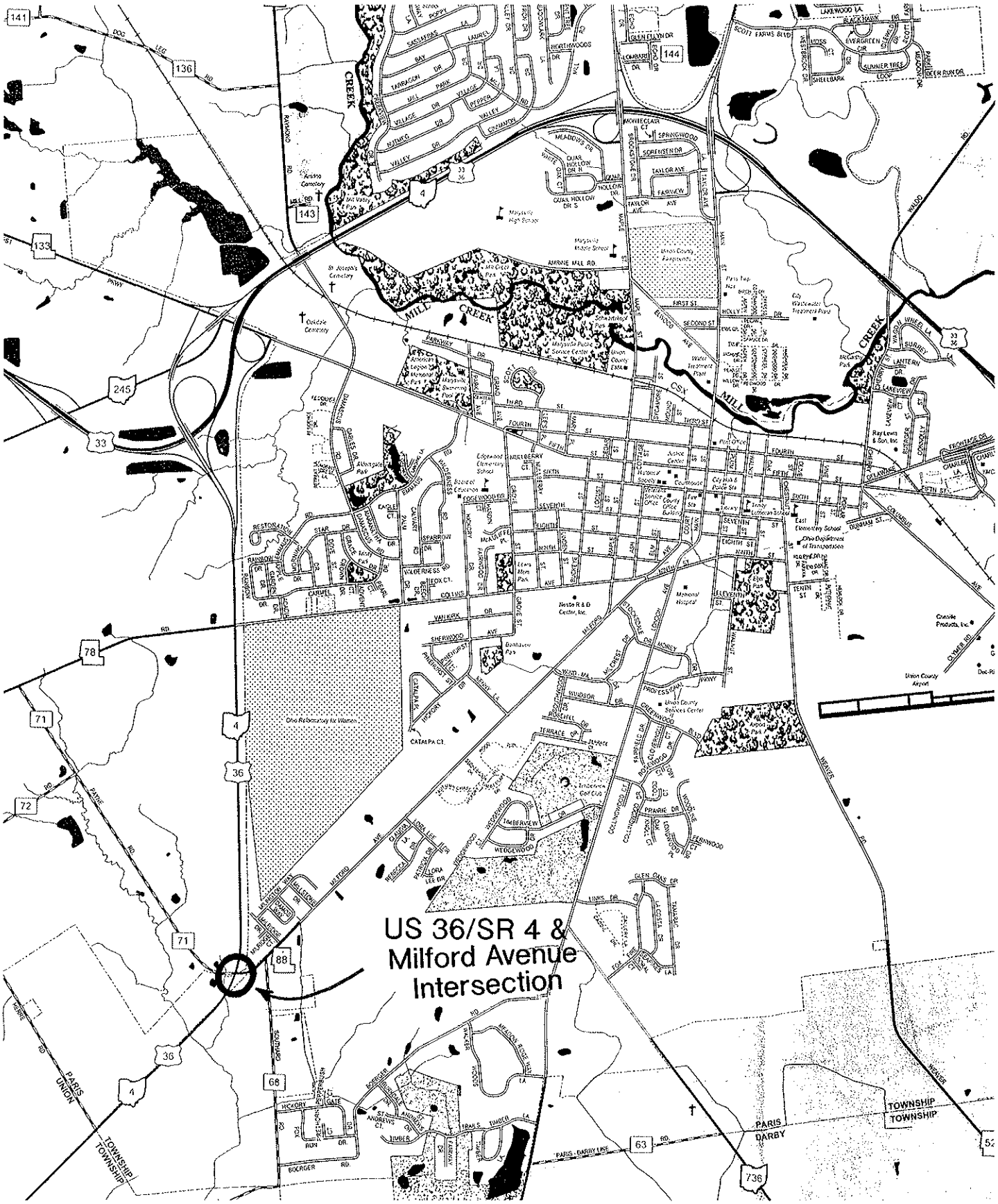
US 36/SR 4 & MILFORD AVENUE TRAFFIC VOLUMES

Marysville, OH

Prepared by

MS CONSULTANTS, INC.

Figure 1: Study Location



Marysville Exempted Village School District

New Intermediate & Middle School

Proposed Site Plan

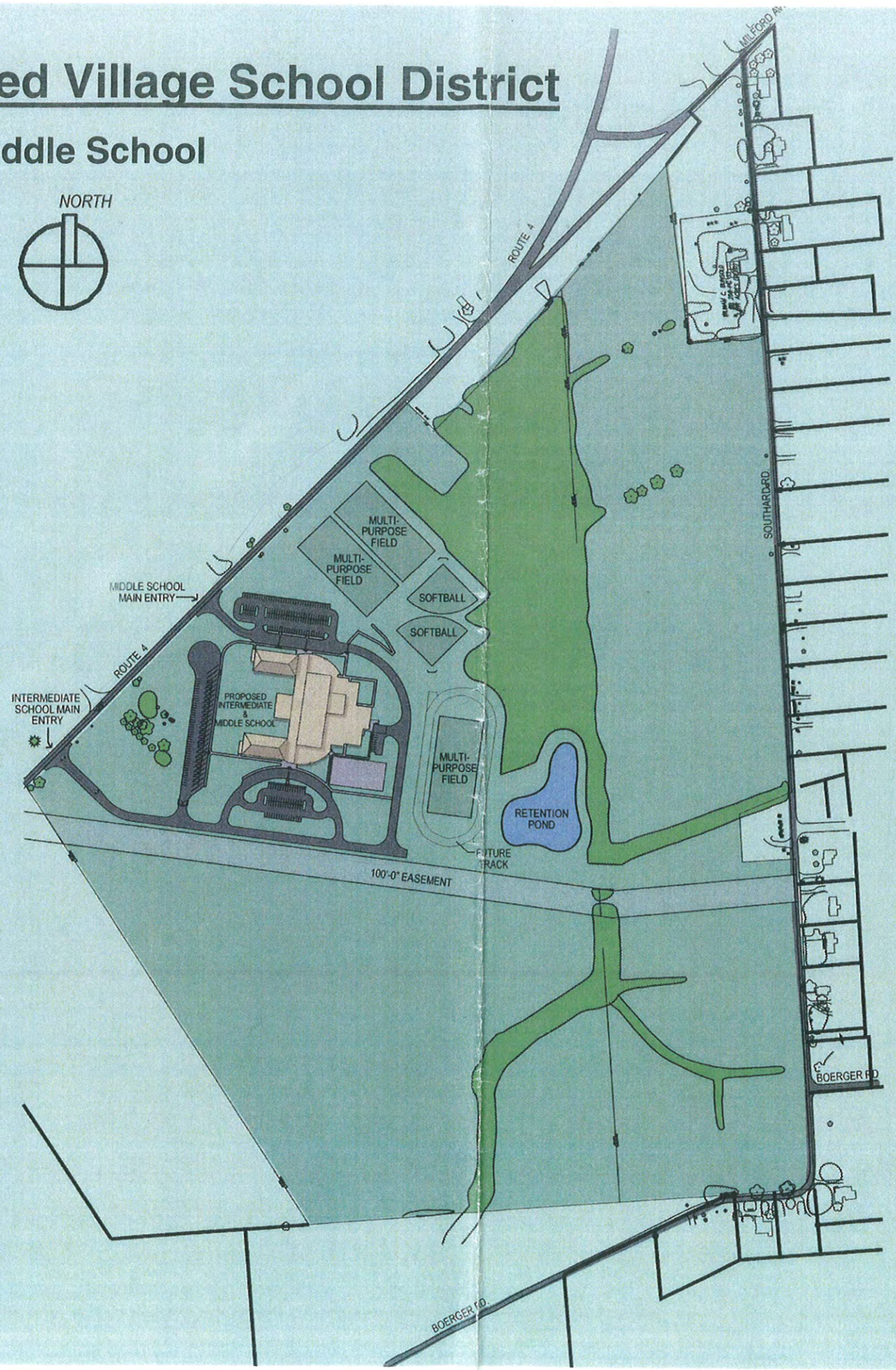


Figure 2

Marysville Exempted Village School District

Future Development – *Year 2016*

Proposed Future Site Plan

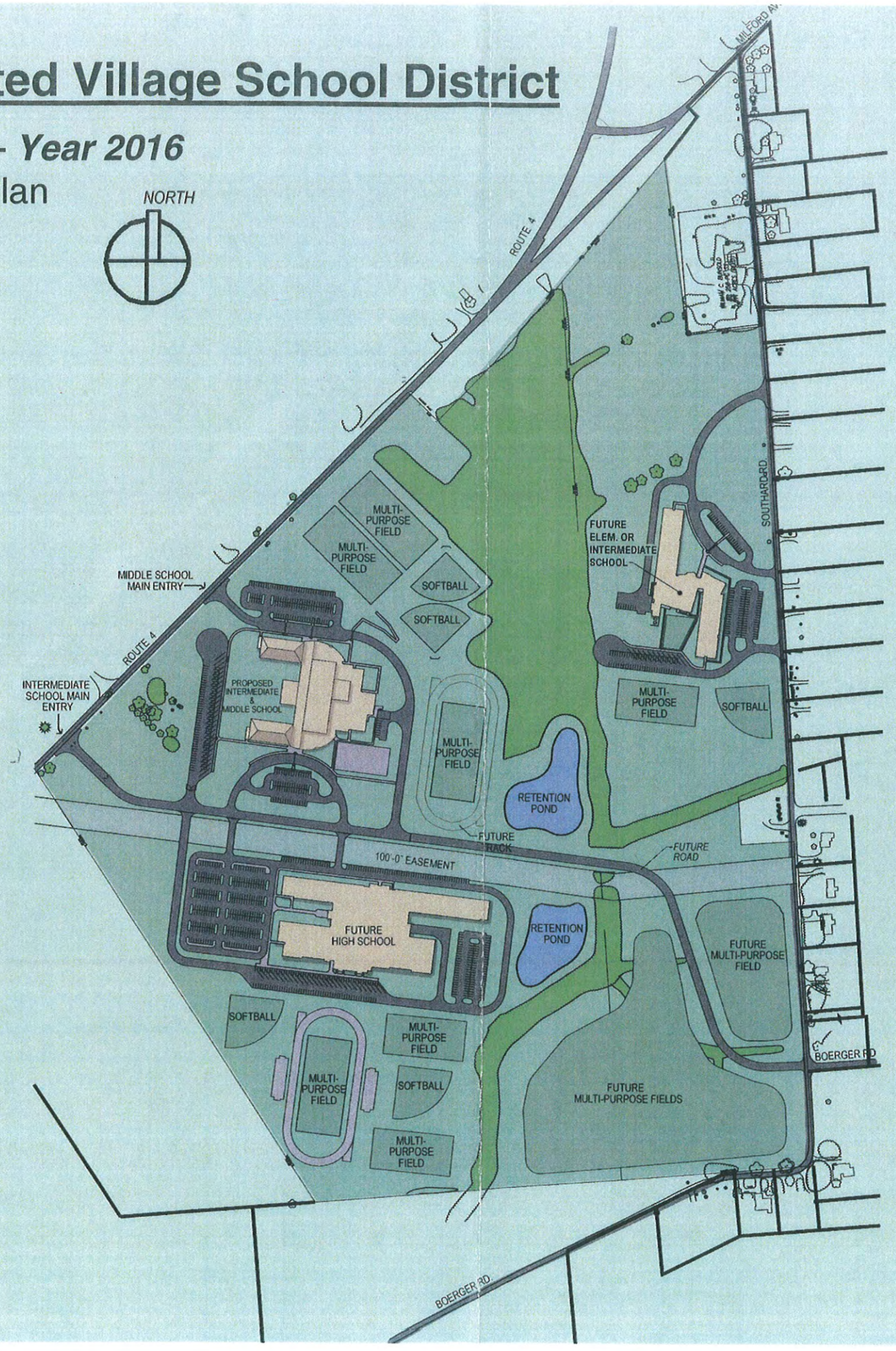


Figure 3

Appendix

Other Relevant Documentation

ms consultants, inc.
2221 Schrock Road
Columbus, OH 43229

Marysville Traffic Study
Marysville, OH
Weekday Peak Hours

File Name : SR4 Milford
Site Code : 00000000
Start Date : 5/22/2008
Page No : 1

Groups Printed- Passenger Cars - Trucks

	MILFORD AVE Eastbound					MILFORD AVE Westbound					RT 4 Northbound					RT 4 Southbound					
Start Time	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Left	Thru	Right	Peds	App. Total	Int. Total
Factor	1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0		
07:15 AM	1	2	0	0	3	6	1	27	0	34	0	51	9	0	60	4	39	0	0	43	140
07:30 AM	0	0	1	0	1	8	1	20	0	29	1	47	17	0	65	4	37	0	0	41	136
07:45 AM	0	5	1	0	6	6	0	19	0	25	0	44	26	0	70	10	44	0	0	54	155
Total	1	7	2	0	10	20	2	66	0	88	1	142	52	0	195	18	120	0	0	138	431
08:00 AM	4	2	0	0	6	4	2	23	0	29	0	36	9	0	45	2	39	1	1	43	123
Total	4	2	0	0	6	4	2	23	0	29	0	36	9	0	45	2	39	1	1	43	123
02:30 PM	0	2	0	0	2	7	2	4	0	13	0	33	14	0	47	6	40	0	0	46	108
02:45 PM	1	3	0	0	4	16	5	8	0	29	0	43	15	0	58	17	47	1	0	65	156
Total	1	5	0	0	6	23	7	12	0	42	0	76	29	0	105	23	87	1	0	111	264
03:00 PM	0	4	0	0	4	22	3	8	0	33	0	33	12	0	45	11	60	2	0	73	155
03:15 PM	0	2	0	0	2	12	3	8	0	23	0	35	10	0	45	13	52	1	0	66	136
Grand Total	6	20	2	0	28	81	17	117	0	215	1	322	112	0	435	67	358	5	1	431	1109
Apprch %	21.4	71.4	7.1	0.0		37.7	7.9	54.4	0.0		0.2	74.0	25.7	0.0		15.5	83.1	1.2	0.2		
Total %	0.5	1.8	0.2	0.0	2.5	7.3	1.5	10.6	0.0	19.4	0.1	29.0	10.1	0.0	39.2	6.0	32.3	0.5	0.1	38.9	

TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	*REB*	Intersection	*US 36/SR 4 & Milford Ave.*
Agency/Co.	*ms consultants*	Jurisdiction	*Marysville, OH*
Date Performed	*10/2/2008*	Analysis Year	*2008*
Analysis Time Period	*AM Peak Hour*		

Project Description

East/West Street: *Milford Avenue*	North/South Street: *US 36/SR 4*
Intersection Orientation: *North-South*	Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	*1*	*273*		*18*	*280*	*1*
Peak-Hour Factor, PHF	*0.90*	*0.90*	*1.00*	*0.90*	*0.90*	*0.90*
Hourly Flow Rate, HFR (veh/h)	*1*	*303*	*0*	*20*	*311*	*1*
Percent Heavy Vehicles	*4*	--	--	*4*	--	--
Median Type	*Undivided*					
RT Channelized			*0*			*0*
Lanes	*0*	*1*	*0*	*0*	*1*	*0*
Configuration	*LT*			*LTR*		
Upstream Signal		*0*			*0*	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	*5*	*8*	*2*	*133*	*4*	*80*
Peak-Hour Factor, PHF	*0.90*	*0.90*	*0.90*	*0.90*	*0.90*	*0.90*
Hourly Flow Rate, HFR (veh/h)	*5*	*8*	*2*	*147*	*4*	*88*
Percent Heavy Vehicles	*4*	*4*	*4*	*4*	*4*	*4*
Percent Grade (%)		*0*			*0*	
Flared Approach		*N*			*N*	
Storage		*0*			*0*	
RT Channelized			*0*			*0*
Lanes	*0*	*1*	*0*	*1*	*1*	*0*
Configuration		*LTR*		*L*		*TR*

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	*LT*	*LTR*	*L*		*TR*		*LTR*	
v (veh/h)	*1*	*20*	*147*		*92*		*15*	
C (m) (veh/h)	*1237*	*1247*	*360*		*703*		*368*	
v/c	*0.00*	*0.02*	*0.41*		*0.13*		*0.04*	
95% queue length	*0.00*	*0.05*	*1.93*		*0.45*		*0.13*	
Control Delay (s/veh)	*7.9*	*7.9*	*21.7*		*10.9*		*15.2*	
LOS	*A*	*A*	*C*		*B*		*C*	
Approach Delay (s/veh)	--	--	*17.6*			*15.2*		
Approach LOS	--	--	*C*			*C*		

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	*REB*	Intersection	*US 36/SR 4 & Milford Ave.*
Agency/Co.	*ms consultants*	Jurisdiction	*Marysville, OH*
Date Performed	*10/2/2008*	Analysis Year	*2008*
Analysis Time Period	*PM Peak Hour*		

Project Description

East/West Street: *Milford Avenue*	North/South Street: *US 36/SR 4*
Intersection Orientation: *North-South*	Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	0	207		42	243	4
Peak-Hour Factor, PHF	0.90	0.90	1.00	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	0	230	0	46	270	4
Percent Heavy Vehicles	4	--	--	4	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	1	0	0	1	0
Configuration	LT			LTR		
Upstream Signal		0			0	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	1	10	0	104	12	25
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	1	11	0	115	13	27
Percent Heavy Vehicles	4	4	4	4	4	4
Percent Grade (%)		0			0	
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	0	1	0	1	1	0
Configuration		LTR		L		TR

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	LT	LTR	L		TR		LTR	
v (veh/h)	0	46	115		40		12	
C (m) (veh/h)	1278	1326	389		603		395	
v/c	0.00	0.03	0.30		0.07		0.03	
95% queue length	0.00	0.11	1.22		0.21		0.09	
Control Delay (s/veh)	7.8	7.8	18.1		11.4		14.4	
LOS	A	A	C		B		B	
Approach Delay (s/veh)	--	--	16.4			14.4		
Approach LOS	--	--	C			B		

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HCS+: Signalized Intersections Release 5.3

Analyst: REB
Agency: ms consultants
Date: 9/3/2008
Period: AM Peak Hour
Project ID: with signal
E/W St: Milford Avenue

Inter.: SR 4 & Milford Ave.
Area Type: All other areas
Jurisd: Marysville, OH
Year : 2008

N/S St: US 36/SR 4

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	1	1	0	0	1	0	0	1	0
LGConfig		LTR		L	TR			LT			LTR	
Volume	5	8	2	133	4	80	1	273		18	280	1
Lane Width		12.0		12.0	12.0			12.0			12.0	
RTOR Vol			0			0						0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4			5	6	7	8
EB	Left	A				NB	Left	P			
	Thru	A					Thru	P			
	Right	A					Right	P			
	Peds						Peds				
WB	Left	A				SB	Left	P			
	Thru	A					Thru	P			
	Right	A					Right	P			
	Peds						Peds				
NB	Right					EB	Right				
SB	Right					WB	Right				
Green		23.0						27.0			
Yellow		4.0						4.0			
All Red		1.0						1.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
LTR	702	1686	0.02	0.42	10.3	B	10.3	B
Westbound								
L	563	1351	0.26	0.42	11.7	B		
TR	646	1550	0.14	0.42	11.0	B	11.4	B
Northbound								
LT	874	1808	0.35	0.48	10.7	B	10.7	B
Southbound								
LTR	852	1763	0.39	0.48	11.2	B	11.2	B

Intersection Delay = 11.1 (sec/veh) Intersection LOS = B

HCS+: Signalized Intersections Release 5.3

Analyst: REB
Agency: ms consultants
Date: 9/3/2008
Period: PM Peak Hour
Project ID: with signal
E/W St: Milford Avenue

Inter.: SR 4 & Milford Ave.
Area Type: All other areas
Jurisd: Marysville, OH
Year : 2008

N/S St: US 36/SR 4

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	1	1	0	0	1	0	0	1	0
LGConfig		LTR		L	TR			LT			LTR	
Volume	1	10	0	104	12	25	0	207		42	243	4
Lane Width		12.0		12.0	12.0			12.0			12.0	
RTOR Vol			0			0						0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	A				NB Left	P		
Thru	A				Thru	P		
Right	A				Right	P		
Peds					Peds			
WB Left	A				SB Left	P		
Thru	A				Thru	P		
Right	A				Right	P		
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	23.0				27.0			
Yellow	4.0				4.0			
All Red	1.0				1.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
LTR	747	1794	0.02	0.42	10.3	B	10.3	B
Westbound								
L	565	1357	0.21	0.42	11.3	B		
TR	677	1624	0.06	0.42	10.5	B	11.1	B
Northbound								
LT	875	1810	0.26	0.48	9.9	A	9.9	A
Southbound								
LTR	816	1689	0.39	0.48	11.3	B	11.3	B

Intersection Delay = 10.8 (sec/veh) Intersection LOS = B

TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	*REB*	Intersection	*US 36/SR 4 & Milford Ave.*
Agency/Co.	*ms consultants*	Jurisdiction	*Marysville, OH*
Date Performed	*10/2/2008*	Analysis Year	*2028*
Analysis Time Period	*AM Peak Hour*		

Project Description

East/West Street: *Milford Avenue*	North/South Street: *US 36/SR 4*
Intersection Orientation: *North-South*	Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	1	349		29	450	1
Peak-Hour Factor, PHF	0.90	0.90	1.00	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	1	387	0	32	500	1
Percent Heavy Vehicles	4	--	--	4	--	--
Median Type	Undivided					
RT Channelized			0			0
Lanes	0	1	0	0	1	0
Configuration	LT			LTR		
Upstream Signal		0			0	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	6	10	2	227	4	128
Peak-Hour Factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Hourly Flow Rate, HFR (veh/h)	6	11	2	252	4	142
Percent Heavy Vehicles	4	4	4	4	4	4
Percent Grade (%)		0			0	
Flared Approach		N			N	
Storage		0			0	
RT Channelized			0			0
Lanes	0	1	0	1	1	0
Configuration		LTR		L		TR

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	LT	LTR	L		TR		LTR	
v (veh/h)	1	32	252		146		19	
C (m) (veh/h)	1053	1161	218		628		221	
v/c	0.00	0.03	1.16		0.23		0.09	
95% queue length	0.00	0.08	12.08		0.90		0.28	
Control Delay (s/veh)	8.4	8.2	155.7		12.5		22.8	
LOS	A	A	F		B		C	
Approach Delay (s/veh)	--	--	103.2			22.8		
Approach LOS	--	--	F			C		

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TWO-WAY STOP CONTROL SUMMARY

General Information		Site Information	
Analyst	*REB*	Intersection	*US 36/SR 4 & Milford Ave.*
Agency/Co.	*ms consultants*	Jurisdiction	*Marysville, OH*
Date Performed	*10/2/2008*	Analysis Year	*2028*
Analysis Time Period	*PM Peak Hour*		

Project Description

East/West Street: *Milford Avenue*	North/South Street: *US 36/SR 4*
Intersection Orientation: *North-South*	Study Period (hrs): *0.25*

Vehicle Volumes and Adjustments

Major Street	Northbound			Southbound		
Movement	1	2	3	4	5	6
	L	T	R	L	T	R
Volume (veh/h)	*0*	*341*		*67*	*321*	*5*
Peak-Hour Factor, PHF	*0.90*	*0.90*	*1.00*	*0.90*	*0.90*	*0.90*
Hourly Flow Rate, HFR (veh/h)	*0*	*378*	*0*	*74*	*356*	*5*
Percent Heavy Vehicles	*4*	--	--	*4*	--	--
Median Type	*Undivided*					
RT Channelized			*0*			*0*
Lanes	*0*	*1*	*0*	*0*	*1*	*0*
Configuration	*LT*			*LTR*		
Upstream Signal		*0*			*0*	

Minor Street	Eastbound			Westbound		
Movement	7	8	9	10	11	12
	L	T	R	L	T	R
Volume (veh/h)	*1*	*12*	*0*	*138*	*14*	*40*
Peak-Hour Factor, PHF	*0.90*	*0.90*	*0.90*	*0.90*	*0.90*	*0.90*
Hourly Flow Rate, HFR (veh/h)	*1*	*13*	*0*	*153*	*15*	*44*
Percent Heavy Vehicles	*4*	*4*	*4*	*4*	*4*	*4*
Percent Grade (%)		*0*			*0*	
Flared Approach		*N*			*N*	
Storage		*0*			*0*	
RT Channelized			*0*			*0*
Lanes	*0*	*1*	*0*	*1*	*1*	*0*
Configuration		*LTR*		*L*		*TR*

Delay, Queue Length, and Level of Service

Approach	Northbound	Southbound	Westbound			Eastbound		
Movement	1	4	7	8	9	10	11	12
Lane Configuration	*LT*	*LTR*	*L*		*TR*		*LTR*	
v (veh/h)	*0*	*74*	*153*		*59*		*14*	
C (m) (veh/h)	*1187*	*1170*	*236*		*474*		*255*	
v/c	*0.00*	*0.06*	*0.65*		*0.12*		*0.05*	
95% queue length	*0.00*	*0.20*	*3.99*		*0.42*		*0.17*	
Control Delay (s/veh)	*8.0*	*8.3*	*44.6*		*13.7*		*19.9*	
LOS	*A*	*A*	*E*		*B*		*C*	
Approach Delay (s/veh)	--	--	*36.0*			*19.9*		
Approach LOS	--	--	*E*			*C*		

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HCS+: Signalized Intersections Release 5.3

Analyst: REB
Agency: ms consultants
Date: 9/3/2008
Period: AM Peak Hour
Project ID: with signal only
E/W St: Milford Avenue

Inter.: SR 4 & Milford Ave.
Area Type: All other areas
Jurisd: Marysville, OH
Year : 2028

N/S St: US 36/SR 4

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	1	1	0	0	1	0	0	1	0
LGConfig		LTR		L	TR			LT			LTR	
Volume	6	10	2	227	4	128	1	349		29	450	1
Lane Width		12.0		12.0	12.0			12.0			12.0	
RTOR Vol			0			0						0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4			5	6	7	8
EB	Left	A				NB	Left	P			
	Thru	A					Thru	P			
	Right	A					Right	P			
	Peds						Peds				
WB	Left	A				SB	Left	P			
	Thru	A					Thru	P			
	Right	A					Right	P			
	Peds						Peds				
NB	Right					EB	Right				
SB	Right					WB	Right				
Green		22.0						28.0			
Yellow		4.0						4.0			
All Red		1.0						1.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
LTR	668	1671	0.03	0.40	10.9	B	10.9	B
Westbound								
L	539	1347	0.47	0.40	13.9	B		
TR	618	1546	0.24	0.40	12.1	B	13.3	B
Northbound								
LT	904	1808	0.43	0.50	11.1	B	11.1	B
Southbound								
LTR	874	1747	0.61	0.50	14.0	B	14.0	B

Intersection Delay = 12.9 (sec/veh) Intersection LOS = B

HCS+: Signalized Intersections Release 5.3

Analyst: REB
Agency: ms consultants
Date: 9/3/2008
Period: PM Peak Hour
Project ID: with signal only
E/W St: Milford Avenue

Inter.: SR 4 & Milford Ave.
Area Type: All other areas
Jurisd: Marysville, OH
Year : 2028

N/S St: US 36/SR 4

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	0	1	1	0	0	1	0	0	1	0
LGConfig		LTR		L	TR			LTR			LTR	
Volume	1	10	0	104	12	25	0	207	114	42	243	4
Lane Width		12.0		12.0	12.0			12.0			12.0	
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination		1	2	3	4			5	6	7	8
EB	Left	A				NB	Left	P			
	Thru	A					Thru	P			
	Right	A					Right	P			
	Peds						Peds				
WB	Left	A				SB	Left	P			
	Thru	A					Thru	P			
	Right	A					Right	P			
	Peds						Peds				
NB	Right					EB	Right				
SB	Right					WB	Right				
Green		22.0						28.0			
Yellow		4.0						4.0			
All Red		1.0						1.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
LTR	718	1794	0.02	0.40	10.9	B	10.9	B
Westbound								
L	543	1357	0.21	0.40	12.0	B		
TR	650	1624	0.06	0.40	11.1	B	11.8	B
Northbound								
LTR	862	1723	0.41	0.50	10.9	B	10.9	B
Southbound								
LTR	829	1657	0.39	0.50	10.7	B	10.7	B

Intersection Delay = 11.0 (sec/veh) Intersection LOS = B

HCS+: Signalized Intersections Release 5.3

Analyst: REB
Agency: ms consultants
Date: 9/3/2008
Period: AM Peak Hour
Project ID: with signal and turn lanes
E/W St: Milford Avenue

Inter.: SR 4 & Milford Ave.
Area Type: All other areas
Jurisd: Marysville, OH
Year : 2028

N/S St: US 36/SR 4

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	0	1	1	0	1	1	1	1	1	0
LGConfig	L	TR		L	TR		L	T	R	L	TR	
Volume	6	10	2	227	4	128	1	349	187	29	450	1
Lane Width	12.0	12.0		12.0	12.0		12.0	12.0	12.0	12.0	12.0	
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
EB Left	A				NB Left	P		
Thru	A				Thru	P		
Right	A				Right	P		
Peds					Peds			
WB Left	A				SB Left	P		
Thru	A				Thru	P		
Right	A				Right	P		
Peds					Peds			
NB Right					EB Right			
SB Right					WB Right			
Green	22.0				28.0			
Yellow	4.0				4.0			
All Red	1.0				1.0			

Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	477	1193	0.01	0.40	10.9	B		
TR	707	1768	0.02	0.40	10.9	B	10.9	B
Westbound								
L	542	1355	0.46	0.40	13.9	B		
TR	618	1546	0.24	0.40	12.1	B	13.2	B
Northbound								
L	310	620	0.00	0.50	7.5	A		
T	905	1810	0.43	0.50	11.0	B	10.5	B
R	769	1538	0.27	0.50	9.5	A		
Southbound								
L	398	795	0.08	0.50	8.2	A		
TR	905	1809	0.55	0.50	12.8	B	12.5	B

Intersection Delay = 11.9 (sec/veh) Intersection LOS = B

HCS+: Signalized Intersections Release 5.3

Analyst: REB
Agency: ms consultants
Date: 9/3/2008
Period: PM Peak Hour
Project ID: with signal and turn lanes
E/W St: Milford Avenue

Inter.: SR 4 & Milford Ave.
Area Type: All other areas
Jurisd: Marysville, OH
Year : 2008

N/S St: US 36/SR 4

SIGNALIZED INTERSECTION SUMMARY

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	0	1	1	0	1	1	1	1	1	0
LGConfig	L	TR		L	TR		L	T	R	L	TR	
Volume	1	10	0	104	12	25	0	207	114	42	243	4
Lane Width	12.0	12.0		12.0	12.0		12.0	12.0	12.0	12.0	12.0	
RTOR Vol			0			0			0			0

Duration 0.25 Area Type: All other areas

Signal Operations

Phase Combination	1	2	3	4			5	6	7	8
EB Left	A				NB	Left	P			
Thru	A					Thru	P			
Right	A					Right	P			
Peds						Peds				
WB Left	A				SB	Left	P			
Thru	A					Thru	P			
Right	A					Right	P			
Peds						Peds				
NB Right					EB	Right				
SB Right					WB	Right				
Green	23.0						27.0			
Yellow	4.0						4.0			
All Red	1.0						1.0			

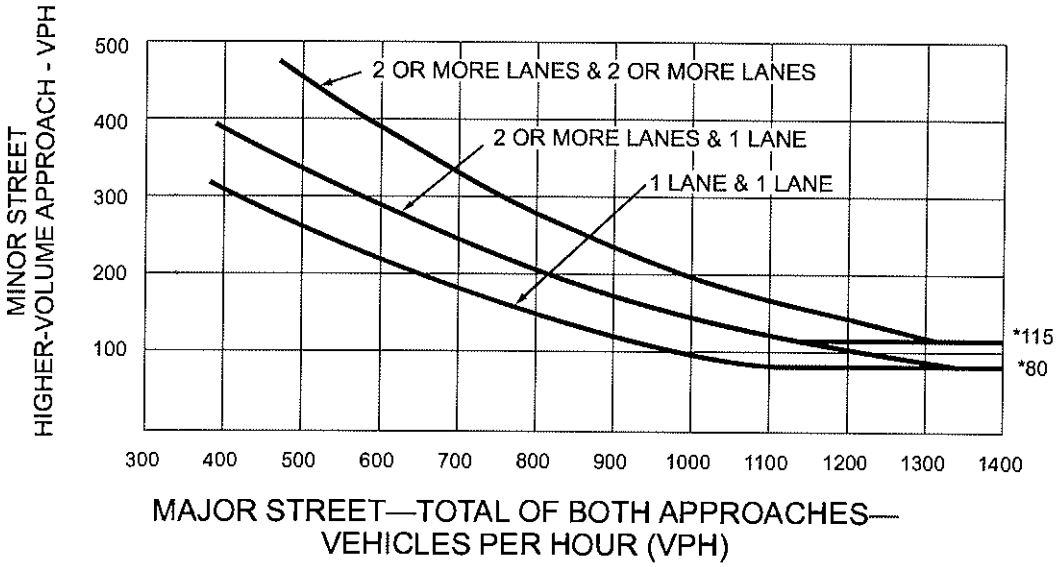
Cycle Length: 60.0 secs

Intersection Performance Summary

Appr/ Lane Grp	Lane Group Capacity	Adj Sat Flow Rate (s)	Ratios v/c	Ratios g/C	Lane Group Delay	Lane Group LOS	Approach Delay	Approach LOS
Eastbound								
L	507	1322	0.00	0.38	11.4	B		
TR	754	1810	0.01	0.42	10.3	B	10.4	B
Westbound								
L	521	1358	0.22	0.38	12.7	B		
TR	677	1624	0.06	0.42	10.5	B	12.1	B
Northbound								
L	471	1047	0.00	0.45	9.1	A		
T	875	1810	0.26	0.48	9.9	A	10.1	B
R	692	1538	0.18	0.45	10.5	B		
Southbound								
L	501	1113	0.09	0.45	9.8	A		
TR	873	1806	0.31	0.48	10.4	B	10.3	B

Intersection Delay = 10.6 (sec/veh) Intersection LOS = B

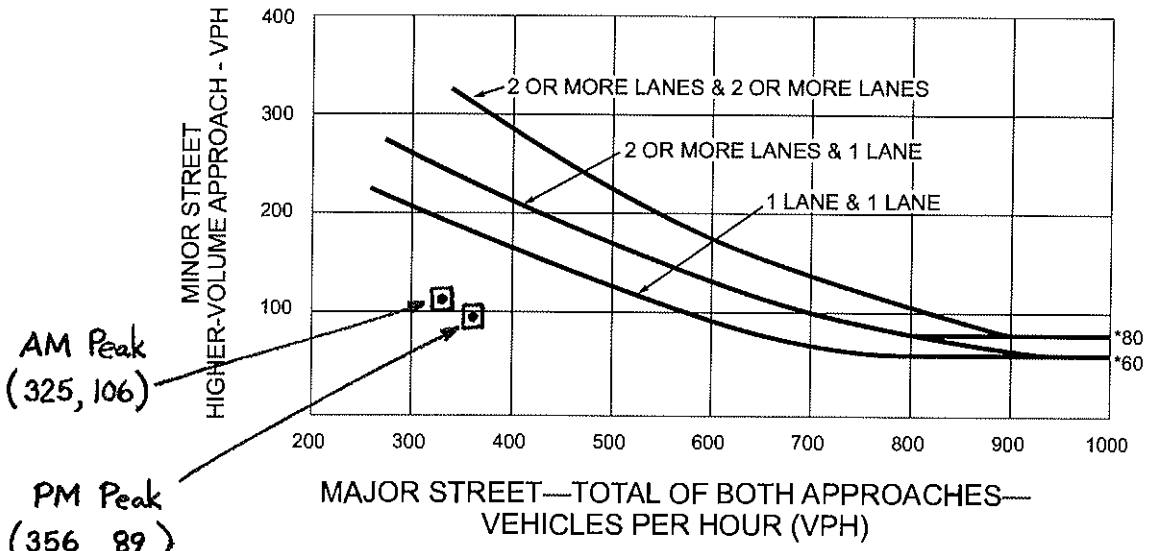
Figure 4C-1. Warrant 2, Four-Hour Vehicular Volume



*Note: 115 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 80 vph applies as the lower threshold volume for a minor-street approach with one lane.

Figure 4C-2. Warrant 2, Four-Hour Vehicular Volume (70% Factor)

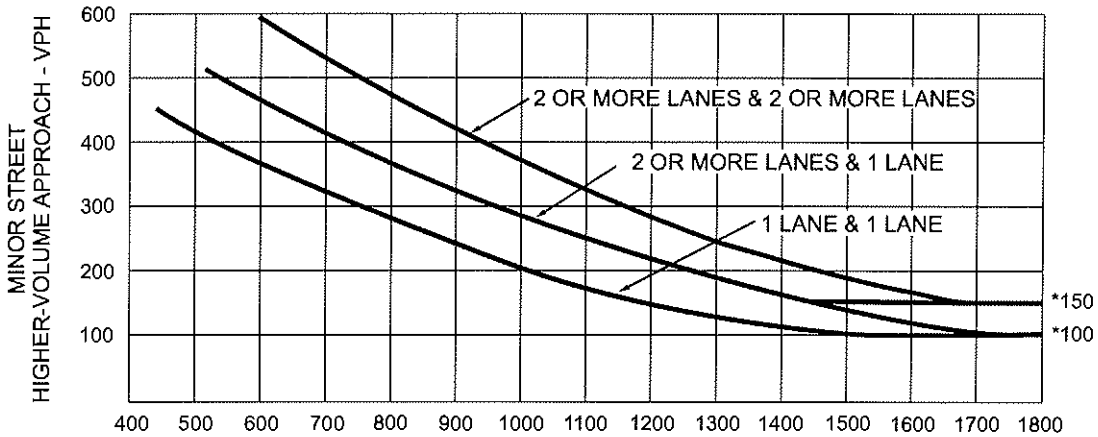
(COMMUNITY LESS THAN 10,000 POPULATION OR ABOVE 70 km/h OR ABOVE 40 mph ON MAJOR STREET)



*Note: 80 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 60 vph applies as the lower threshold volume for a minor-street approach with one lane.

NOT WARRANTED

Figure 4C-3. Warrant 3, Peak Hour

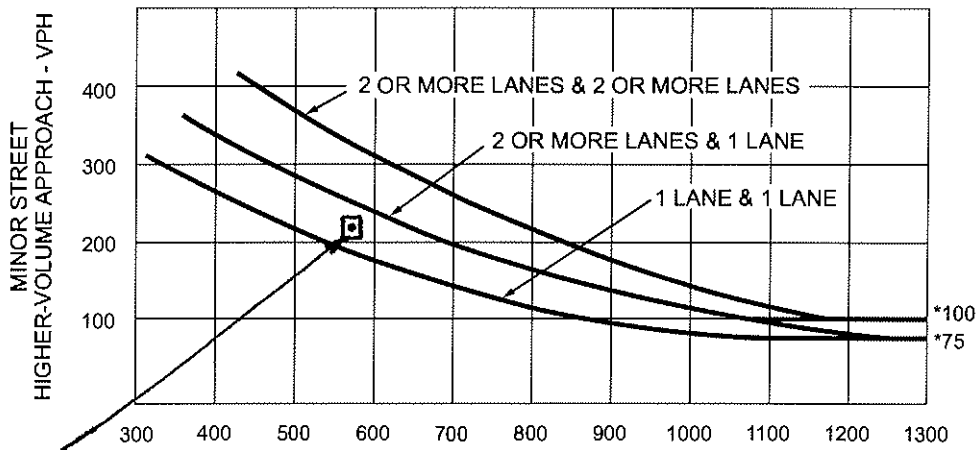


MAJOR STREET—TOTAL OF BOTH APPROACHES—
VEHICLES PER HOUR (VPH)

*Note: 150 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 100 vph applies as the lower threshold volume for a minor-street approach with one lane.

Figure 4C-4. Warrant 3, Peak Hour (70% Factor)

(COMMUNITY LESS THAN 10,000 POPULATION OR ABOVE 70 km/h OR ABOVE 40 mph ON MAJOR STREET)



AM Peak
(573, 217)
WARRANTED

MAJOR STREET—TOTAL OF BOTH APPROACHES—
VEHICLES PER HOUR (VPH)

*Note: 100 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 75 vph applies as the lower threshold volume for a minor-street approach with one lane.